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to general biology



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PATHOLOGY IN ITS RELATIONS TO GENERAL BIOLOGY

—BY—

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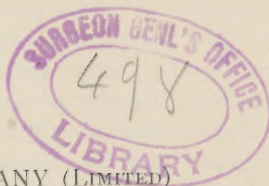
Presented by the author

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I esteem it a privilege to assist at the formal opening of this Biological Laboratory and to be able to extend to this University, and to this City, congratulations for the possession of a laboratory so admirably constructed and equipped and inaugurated with the assurance of an activity so fruitful and well directed. The existence in this place of such a laboratory is not a matter of local pride alone. It may safely be predicted that its influence will be felt throughout this country, and indeed wherever interest in the biological sciences is found.

With such opportunities as here exist, we may feel assured that this country will increase and expand the honorable reputation already gained by its contributions to biological knowledge.

Biology in its widest significance is the study of life in all its forms and activities, both normal and abnormal. No branch of human knowledge can exceed this in interest and importance; none has made greater advances during this century of scientific progress; none has achieved greater triumph for human welfare; none has influenced more profoundly modern philosophical thought.

I am here to say a few words concerning one department of biology, namely, pathology, particularly in its relations to general biology.

Pathology is the study of life in its abnormal forms and activities. The relations of pathology to practical medicine are necessarily so essential and intimate, that the broader conception of this science as a part of biology is in danger of being lost from view. I deem it, however, important for the scientific status and advancement of pathology to keep in mind and to emphasize its relations to general biology, not less than those to practical medicine.

In so doing, it is not intended to detract in any degree from the practical value of pathology

and its applications to the diagnosis and treatment of disease. When we consider that pathology embraces the investigation of the causes of disease, of the anatomical changes produced by disease in the organs and tissues of the body, and of the alterations in function resulting from disease, it is plain that pathology must constitute the scientific basis of practical medicine. This is not the less true because the prevention and cure of disease have not kept pace with the advances in our knowledge of the nature and causes of disease, and of necessity can not do so. Preventive and curative medicine, however, is constantly making beneficent application of pathological discoveries, and the most intelligent and efficient management of disease is becoming more and more that which is founded upon the most accurate knowledge of its nature and causes.

Inasmuch as the general public naturally interests itself but little in any side of medicine other than the treatment of disease, there is not sufficient general appreciation of the immense progress in the science and art of medicine of to-day as contrasted with that of a half century ago. The history of medicine is in large part the history of schools of doctrine. Stately superstructures of sweeping generalizations and attempted explanations were erected only to be overthrown because it was impossible to build upon a firm foundation of facts. To-day it is our conviction that these fundamental facts can be discovered in no other way than by observation and experiment. The adoption of this, the only scientific method of investigation, has with the aid of modern instruments and devices not only greatly enriched medical science, but it has overthrown the era in which, among scientific physicians, exclusive schools of doctrine can prevail. The scientific physician, no more than the scientific chemist, can yield

adherence to any exclusive dogma. To the one as to the other no way which leads to truth is debarred.

By way of illustration of the achievements of modern pathology, permit me to contrast for a moment with the imperfect, meagre, and confusing information of former times, the fulness of our present knowledge concerning that disease, which of all diseases is the greatest scourge of the human race. Tuberculosis causes the death of not less than one-seventh, and, in some form or other and at some period, affects probably one-third of mankind. But a few years ago, not only was the specific cause of tuberculosis unknown, but there was no general appreciation of the fundamental fact that this is one of the infectious diseases. The knowledge of the frequency and wide distribution of tuberculous disease in other parts of the body than in the lungs is an acquisition of modern pathology. The pathological anatomy of tuberculosis, which not long ago was one of the most confusing chapters in pathology, has been made clear. The unity of all the processes now known to be tuberculous can be established on an anatomical as well as on an etiological basis. The greatest addition to our knowledge of tuberculosis, and in fact one of the greatest achievements of modern science, is the discovery of the specific living germ which causes tuberculosis. We are now enabled to study both within and without the body, the form and the properties of this germ, the conditions which are favorable and those which are hostile to its preservation and development. Who can doubt that all this increased knowledge of the most devastating of maladies is destined to help in prevention and treatment? Sanitarians convinced of the preventability of tuberculosis have already begun the warfare against its spread.

If one seeks an illustration of immediate practical results of the modern investigations of the living germs which cause disease, let him turn his attention to the revolution thereby wrought in surgical procedures. The possibility which is now in the hands of the surgeon of keeping wounds free from all external infection, is a boon to humanity not less than the introduction of vaccination.

It would be pleasant to follow still further

the practical benefits resulting from pathological discoveries, but it is not my intention on this occasion to dwell upon the applications of pathology to practical medicine. I have said enough to remove any misapprehension as to my belief that pathology should be made to serve the ultimate aim of medical education, the prevention and cure of disease. This science must ever hold a foremost place in any proper scheme of medical education.

This occasion is an appropriate one to emphasize especially those scientific aspects of pathology which give it an important position among the biological sciences.

In the first place, I claim that pathology as a science, quite independently of any practical or useful applications whatever, is as legitimate and worthy an object of pursuit as any of the natural sciences. In and for itself alone it deserves to be studied. Its methods are those of observation and experiment, as in other biological sciences. Its subject matter is any living thing which deviates from the normal condition. It is not less interesting and important to learn the nature and causes of abnormalities in form and function than it is to become familiar with the normal, and when this knowledge may aid in the prevention and relief of suffering, added dignity and interest are imparted to the study.

As there comes a line where the distinction between the normal and the abnormal is shadowy and uncertain, so the separation between normal and pathological biology is not sharp. The province of the one encroaches at many points upon that of the other. Mutual aid is to be derived from a closer union between normal and pathological biology. The pathologist should not be content with methods of research less perfect than those employed in normal biology. He should not rest satisfied with results which stop at the mere description and classification of morbid processes. To be able to give a name to some pathological lesion, and to make it fit into some accepted scheme of classification, should not be the sole aim of pathological study. Pathological processes should be studied with the aim of elucidating their real nature, development and causes, their mutual relations and their dependence upon underlying laws. The purely descriptive phase

of development of any natural science can be only temporary and unsatisfactory. The more a pathologist is imbued with the spirit of modern biology, the less content will he be to stop at this descriptive phase.

In the next place, it can be justly claimed that the study of pathology as a science without immediate reference to practical results is, in reality, the method which is most likely to yield these results as well as to bear fruit in other directions. Experience has shown that the most important discoveries in science come, not from those who make utility their guiding principle, but from the investigators of truth for its own sake, wherever and however they can attain it. It is short sighted to fail to see that the surest way to advance pathology, even in its relations to practical medicine, is to cultivate it as a science from all points of view. It is impossible to foresee what may be the practical application to-morrow of any pathological fact discovered in the laboratory, no matter how remote from practical bearing it may seem to-day.

The experiments upon animals and other investigations which have led to the pre-ent accuracy in the localized diagnosis of lesions of the central nervous system, and have rendered possible the surgical treatment of many of these lesions we owe in large part to physiologists and pathologists who had little thought of the practical applications of the results of their researches. The instrument and methods which have enabled ophthalmology to attain such perfection in diagnosis and treatment rest upon researches in physiological optics belonging to the domain of pure science. It could not have been anticipated by those who began the study of the microscopic organisms which cause fermentations and infectious diseases, that their study would lead to a revolution in surgical treatment, and would open prospects which it would now be hazardous to specify as to the prevention and cure of infectious diseases. Did time permit, and were it necessary, much more evidence of similar character could be brought forward to show that those who work in laboratories, it may be without a thought as to the practical utility of their investigations, are no less genuine contributors to the science and art of medicine, than those who study diseases by the bedside.

As has already been mentioned, pathology has to do with abnormalities, not in man alone, but in all living things, both animal and vegetable. The points of contact between animal and vegetable pathology are more numerous than might at first glance appear. The student of animal pathology can draw many instructive lessons from such subjects as the behavior of wounds and the parasitic affections in plants. We are most of us probably inclined to think too much of the separation between the pathology of man and that of the lower animals. While there is a wide distinction in the dignity of the object of study, yet from a scientific point of view this separation is of little account. Pathological investigations of diseases of animals constitute no less genuine and valuable contributions to pathology in general, than do similar investigations of human diseases. The advancement of recent years in the education and aims of those who devote themselves to animal pathology, will serve to bring into closer relations the students of human and those of comparative medicine.

It may be useful for us to consider briefly some of the relations and points of contact between human and comparative pathology.

In the first place there are many diseases which are common to man and to animals. These can often be studied to greater advantage upon animals in which many conditions can be controlled, which are beyond our control in man. In animals every stage of development of the disease can be studied, and in general, fresher material can be obtained. We can modify in various ways external and internal conditions so as to reach a clearer comprehension of the morbid processes. Moreover, the same disease may present interesting pathological peculiarities in different species of animals, so that the study of its occurrence in a single species affords most incomplete knowledge. For instance, the pathologist whose sole knowledge of such a disease as tuberculosis is derived from the study of the disease as it occurs in man, has a far less complete understanding of this affection, than one who is also familiar with the striking peculiarities of this affection in cattle, swine, fowls, and other animals.

Especial importance attaches, of course, to the study of such diseases as are communicable

from animals to man, as for instance, anthrax, glanders, tuberculosis, many entozoic affections, etc., and in general these are the animal diseases which have received the most attention from the students of human pathology.

One of the most important departments of comparative pathology is experimental pathology, the value of which to human pathology has long been recognized. To make of experimental pathology a distinct specialty, and to endow it with a separate professorship as is done in some foreign universities, does not seem to me to be in the direction of the most fruitful and healthy development. The experimental method is the handmaid of pathology in all its branches, and is the only means of solving many important problems. The experimental production of diseases in the lower animals affords an insight to be gained in no other way as to the causes, development, lesions and functional manifestations of many diseases. Experience, however, has shown that grave errors are likely to be committed by experimental pathologists who have no knowledge of the natural diseases and conditions of the animals used for experimentation. How often, for example, have those studying the question of experimental tuberculosis mistaken for genuine tubercles nodules produced by parasitic entozoa, and to what misleading conclusions have such incorrect observations led.

There are as many general pathological processes which can be studied to better advantage in animals than in man. Such subjects as inflammation, œdema, thrombosis, embolism, and infection have been elucidated in large part by observations made on animals. Due caution is of course to be exercised in applying such observations directly to human beings.

Inasmuch as it is rarely possible for us to produce artificially all of the conditions which cause natural diseases, and as our very method of experimentation is in itself often a perturbing factor, it is no less important to study animal diseases resulting from natural causes, than it is to study the same diseases experimentally produced. Of course there are many diseases which have not yet been opened to the experimental method of investigation.

Questions of etiology and of pathogenesis are among those which have received and are

destined still further to receive the greatest illumination from studies of comparative pathology. At present, probably no subject engages the attention of pathologists to a greater degree than the microscopic organisms which cause infection. If we had been confined to human beings in the study of infectious diseases, our knowledge in this direction would have been only a small fraction of what it is at present. In no single instance could the complete chain of proof required to demonstrate the causation of an infectious disease by a specific micro-organism have been furnished. The far-reaching principle of preventive vaccination or inoculation would not be known.

A most important and promising field of pathological study, at present only partly cultivated, is found in the infectious diseases of animals and of plants, not only on account of the great economic interests often involved, but also as a means of widening and deepening our conceptions as to the causes, development, prevention and treatment of infectious diseases in general. Any pathologist who is at all familiar with the remarkable and peculiar conditions under which the so-called Texas Cattle Fever of the United States develops and spreads, will realize that the complete elucidation of all the etiological factors of this disease not only would contribute to the solution of a great economic question, but also would open fresh points of view in our conceptions of infectious agents and their properties. When we consider the many conditions which it is in our power to control in studying animal diseases, and above all the possibility of submitting to an experimental crucial test our conclusions, it is clear that the study of natural and artificial infections, as well as of many other diseases in animals, is calculated to advance in the highest degree the science of pathology. It is not a small thing that questions which were once considered to be wholly transcendental, as for instance the doctrine of immunity against infectious diseases, have been brought within the working domain of experimental pathology.

Nor is it in the causation of infectious diseases alone that the comparative study of human and of animal diseases is destined to advance etiology. It is reasonable to expect that this comparative study will help to clear up many

factors, at present obscure, in the causation of human diseases, including the influence of social conditions.

But let us take a broader view of comparative pathology than that which considers abnormalities only in man and in animals related to man in structure and function. I believe that many problems and facts in human pathology await for their complete elucidation the same application of the comparative method of study which has made of normal anatomy virtually a new science. What a barren mass of apparently unrelated facts is human anatomy when studied without reference to comparative anatomy and embryology! If knowledge is the understanding of the real nature of a thing, and how it came to be as it is, then there is no knowledge of human anatomy without the aid of comparative anatomy and embryology. How difficult and unmeaning is the old method of studying the anatomy of the human brain and how fascinating does the anatomy of this organ appear in the light of development!

A light similar in kind, if not equal in intensity, will be shed upon human pathology by a fuller insight into comparative pathology. We possess at present scarcely the rudiments of a comparative general pathology, but how useful and significant is even our fragmentary knowledge of this subject. The charm and impressiveness with which Metschnikoff has developed and presented the phagocytic doctrine is due largely to illustrations drawn from comparative pathology. It is impressive to see pictured in living forms, from the lowest up to the highest, the combat with invading micro-organisms of infection. While the phagocytic doctrine can not be accepted in its entirety, it is interesting to observe that it received its origin and its chief support from observations made upon the lower forms of life, rather than from those on man and the higher animals.

The interesting and important discoveries concerning the curious parasitic organisms associated with malaria may seem to the student of human pathology anomalous and without analogy, but in Prof. Wright's admirable address to-day upon the sporozoa, we have had presented to us not only the life history of the class of organisms to which the malarial

parasites probably belong, but also many examples of similar parasitic affections of lower animals. We may expect still further information concerning this interesting group of infectious micro-organisms from researches in comparative pathology.

Take, for instance, one of the most disputed and still unsettled problems in pathology, the conditions which cause multiplication of the fixed cells of the body, a question which is intimately associated with the still broader one of the response of cells to the action of external stimuli. Can it be doubted that if we were acquainted with the behavior of cells in all types of living things, from the unicellular organism upward, under the influence of such stimuli as cause inflammation in human beings, under the influence of losses of substance and under various other conditions, we should have a much clearer comprehension of one of the fundamental and most common pathological processes in man?

The interesting studies of heredity by Weismann and others pertain in part to pathology, and also illustrate brilliantly the value of the comparative method of research.

The application of embryology to the explanation of congenital malformations is familiar and has long been an acquisition of human pathology. More recent is the endeavor to refer the origin of the genuine tumors to anomalies in foetal development. It is probable that experimental and comparative pathology also will shed much light upon the still obscure question as to the origin of tumors.

A large mass of observed pathological facts we must now accept without adequate explanation. It is often the fundamental and common morbid processes which are most obscure. For many of these we may hope to find satisfactory explanation in the results which the comparative study of pathology will afford. At present nothing is to be gained by attempting to generalize from scanty and incomplete observations in comparative pathology. We must first accumulate a store-house of facts. We need investigators who shall study pathological conditions, not in man alone, or in the higher animals alone, but also in the simpler forms of plant and animal life. Something has been done in this direction, more indeed than

is generally utilized in human pathology, but much more remains to be done. Conditions and processes which are difficult to comprehend in animals of complex organization often become clear in organisms of simple structure. Our pathological concepts are now derived almost wholly from observations made upon highly complex forms of life. I believe it to be no illusion to anticipate in thought a time when all forms and kinds of living matter will be included in the domain of pathology, and when pathological laws will be derived from results of investigations which begin with unicellular organisms and which end with man. By the adoption of this comparative method of study, pathology will in reality acquire greater simplicity and deeper significance than it now possesses.

As the student of normal biology does not attempt to cultivate equally the whole field belonging to his subject, so the pathologist can-

not be expected to cover in his investigations the whole domain of pathology as thus broadly outlined. There will be special workers in various departments. As in normal biology, so in pathological biology from the combined labors of all there will be constructed a science broader, richer and fuller of meaning than that which we now possess. The ideas which I have endeavored to present, although necessarily in a brief and cursory manner, concerning pathology in its relations to general biology, are naturally suggested by the opening of this biological laboratory. Permit me, in conclusion, to say that it is in a medical school in intimate and organic connection with a university where such laboratories exist that the highest cultivation of pathology as a science is to be expected. Here is the favorable atmosphere, here the stimulus of allied sciences, and here the most enlightened appreciation and encouragement.



